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(54) Stone extractor for the transurethral removal of ureter stones

Claims

1. Stone extractor for the transurethral removal of stones located in the ureter, composed of a flexible catheter tube of plastic or similar and a flexible pulling and pushing unit, e.g. cable or similar, which can be displaced along in the catheter tube, to activate a gripping device provided at the free end of the catheter tube for the stone, characterized in that the gripping device consists of a cup-shaped head (7, 16, 23, 27, 33), developed in the manner of a bell or funnel at the free end of the pulling and pushing unit (8), which is open to the front and, as a result of the pushing movement of the activator, opens jaw-like in the direction of the free end and, by means of the pulling movement of the activator (8), is essentially closable on the diameter of the catheter tube (5).
2. Stone extractor according to claim 1, characterized in that the dish head (7, 16, 23, 27) is formed from – viewed in cross-section – arched, leaf-shaped wings (9, 17, 24, 28).
3. Stone extractor according to claim 1 or 2, characterized in that the wings (9) are housed swivellable about a transverse axis (10) and are connected in articulated manner to the pulling and pushing unit (8) by means of butt straps (12).
4. Stone extractor according to claim 1 or 2, characterized in that the wings (17) are arranged adjustable in the manner of a spatial iris diaphragm (Figs. 8-10).
5. Stone extractor according to claim 4, characterized in that the wings (17) are arranged overlapping and are kept spread apart from one another by elastic elements (19), e.g. springs, rubber-elastic buffer units or similar, and in that the catheter tube (5) has at the free end a part (5a) running conically outward in which the wings (17) are housed.

6. Stone extractor according to claims 4 and 5, characterized in that the lower parts of the wings (17) have an edge (17b) bent inwards with which the front end (8a) of the pulling and pushing unit (8) engages.
7. Stone extractor according to claim 1 or 2, characterized in that the wings (24) form part of the catheter tube (5), in that spring plates (25) are arranged at the front end of the pulling and pushing unit (8), which keep the wings (24) pressed outwards.
8. Stone extractor according to claim 1 or 2, characterized in that the wings (28) form part of the catheter tube (5) and moulded-in spring plates (29) are arranged in the wings (28), which keep the wings (28) together in the closed position, and in that the front end (13) of the pulling and pushing unit (8) has a conically expanded, rigid part (30).
9. Stone extractor according to claim 1, characterized in that the catheter tube (5) is provided at the free end with an elastic section (34) running conically outward to which an encircling pull cord (35) is connected, the end (35a) of which is securely attached to the section (34), and which is guided with its other part (35b) to the rear end of the catheter tube (5) and out of this.
10. Stone extractor according to claim 9, characterized in that the encircling pull cord (35) is arranged on the outside or inside of the conical section (34) or in the material of same.

VON KREISLER SCHÖNWALD EISHOLD FUES  
VON KREISLER KELLER SELTING WERNER

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Stone extractor for the transurethral removal of ureter stones

15 The invention relates to a stone extractor for the transurethral removal of stones located in the ureter, composed of a flexible catheter tube of plastic or similar and a flexible pulling and pushing unit, e.g. cable, which can be displaced along the catheter tube, to activate a gripping device provided at the free end of the catheter tube for the stone.

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The so-called loop catheter is known for treating ureter stones by mechanical removal. This has a catheter tube at the front end of which is attached a pulling unit, e.g. a thread or similar, which enters the catheter tube at a specific distance from the front end and runs to the rear end, i.e. the activation  
25 end. By pulling on the pulling unit, the front end of the catheter tube forms into a loop. The stone located in the ureter is to be grasped by this loop as with a lasso and pulled out of the ureter. Loop catheters are also provided in which a double loop can be formed with the help of two pull threads. Ureter stone extractors are also known in the front end of the flexible catheter tube of which  
30 several longitudinally-running fine wires are housed which are securely connected to the flexible pulling and pushing unit with one end. The free ends of the wire bundle are likewise securely connected to one another to form a rounded-off tip. Once the wire bundle is pushed out of the catheter tube, the fine wires endeavour to bulge radially outwards, a longitudinally extended,

somewhat bulged-out basket being formed. The wires can assume a spiral course. Because the wires bulge out, they form a free space between one another which is intended to make it possible to allow the stone to reach the inside of the basket with the result that it is held captive by the basket. When  
5 the catheter tube is pulled out, the stone is to be removed with it.

When operating the two previously known catheters mentioned above, it is a prerequisite for catching the stone in the relatively narrow ureter that the front catheter end can be guided past the stone in the ureter, i.e. that the stone  
10 trapped in the ureter can be passed by the catheter. Only then can the stone be grasped as a result of the loop formation of the catheter tube or by means of the wire basket and pulled out of the ureter. Such an operation is frequently a matter of luck. Many attempts must be made to be able to bring the catheter with the gripping device into the correct catching position, i.e. to be able to  
15 guide the catheter around the stone in the ureter. The mucous membrane is often damaged in the process. The mucous membrane is torn. It also happens that with frequent operations perforations are caused by the tip of the catheter tube or the wire bundle, even if these are rounded off. A ureter tear is also possible. The danger of infection is extremely high.

20 The object of the invention is to create a stone extractor of the type described at the outset with which it is made possible to be able to catch a stone trapped in the ureter in a more certain and careful manner and pull it out of the ureter. The invention is characterized in that the gripping device consists of a cup-  
25 shaped head, developed in the manner of a bell or funnel at the free end of the pulling and pushing unit, which is open to the front and, as a result of pushing movements of the activator, opens jaw-like in the direction of the free end and, by means of the pulling movement of the activator, is essentially closable on the diameter of the catheter tube.

30 The effect of such a development of the gripping device for the catheter is that the process for catching the stone is to be undertaken in a substantially different manner than was customary to date. The catheter need be brought only as far as the stone in the ureter, the cup-shaped catching head being

kept closed. The catching head is then moved into the open position by advancing the pushing unit with the result that a mouth open towards the stone is formed. By opening the catching head, the wall of the ureter can be expanded all the way round. This has the effect that the stone, which in most cases is trapped in the ureter, can become loose on its own. This is because, underneath the stone, the ureter thus acquires a larger clear cross-section which in many cases can cause the stone to slide on its own into the opened mouth of the catching head. The open mouth of the catching head can then be closed again by means of the pulling unit, the stone being located wholly or at least partly inside the catching head. When the stone is pulled further out of the ureter, the internal wall of the ureter no longer comes into contact with the stone because the parts of the catching head are in between. The roughness on the stone can therefore no longer cause injuries or irritations or similar to the mucous membrane. The stone clamped by the more or less closed catching head can be pulled smoothly out of the ureter. The gripping device according to the invention makes possible a very careful operation. The mucous membrane of the ureter is not very irritated, as a result of which the process of removing the stone from the ureter remains essentially bloodless.

In the closed state, the catching head according to the invention projects hardly, or not at all, out over the periphery of the catheter tube. On the other hand, it is ensured by the activator for the jaw-like opening of the gripping device that the mouth of the gripping device can be moved, when subjected to force, into the opening process with the result that a reliable expansion of the ureter can be controlled just in front of the stone. Depending on the shape of the stone, the stone is very quickly released from its position trapped in the ureter. The initial loosening and the initial slipping movements of the stone can be carefully supported by slight further opening of the mouth of the gripping device. During the closing process of the mouth of the gripping device, the stone is either wholly captured or it is held clamped by the mouth edges. In both cases, the mucous membrane of the ureter is handled extremely carefully upon further pulling out from same.

According to a further feature of the invention, the dish head is formed – viewed in cross-section – from arched, leaf-shaped wings. The leaf-shaped parts form a relatively large bearing surface on the internal wall of the ureter, as a result of which on the one hand the process of expanding the ureter can  
5 be realized safely and reliably. On the other hand, the mucous membranes are scarcely irritated when the catching head is displaced in the ureter.

In another version, the wings can be housed swivellable about a transverse axis. They are expediently connected in articulated manner to the pulling and  
10 pushing unit by means of butt straps, as a result of which the opening and closing of the mouth of the catching head is made possible.

In another version, the leaf-shaped wings can be arranged adjustable in the manner of a spatial iris diaphragm. The wings can be attached overlapping,  
15 being kept spread apart from one another by elastic elements, e.g. springs, rubber-elastic buffer units or similar. The catheter tube can have at the free end a conically expanded part in which the wings are housed. The wings can be opened and closed by means of the pulling and pushing unit through reciprocal displacement.

20 In a different design of the catching head that can be opened and reclosed in the manner of a jaw, the leaf-like wings can form a direct part of the catheter tube, moulded-in spring plates or similar being able to be arranged in the wings which keep the wings in the closed position. The front end of the pulling  
25 and pushing unit can have a conically expanded part through the adjustment of which the opening and closing of the wings can be undertaken. It is also possible with this design to equip the front end of the pulling and pushing unit with spring plates which act on the leaf-shaped wings.

30 A further version for the cup-shaped catching head can also consist of the catheter tube being provided at the free end with an elastic section running conically outward. An encircling pull cord which leads to the rear end of the catheter tube is expediently connected to this conical section. By pulling on



the pull cord, the conical section is gathered at the upper end against the elastic spreading effect of the cone section.

In all cases, the cup-shaped catching head of the invention can be closed  
5 such that an easy insertion into the ureter opening and an advancement in the ureter itself is ensured.

The invention will be explained in more detail hereafter with reference to the embodiments shown in the drawing.

10

Figs. 1, 2 and 3 show a first version of a catheter with the gripping device according to the invention in three different phases in longitudinal section and in detail, schematically.

15 Figs. 4 to 7 show details of the gripping device of the invention of Figs. 1 to 3, Figs. 4 and 5 showing a view and a top view, whilst Figs. 6 and 7 illustrate the movement mechanism in section through the gripping device.

20 Figs. 8, 9 and 10 show in diagrammatic form and in section a second version of the design of the gripping device according to the invention in the manner of a spatial iris diaphragm, diagrammatically and in section, schematically.

Fig. 11 shows a third version for the adjustment of the leaf-shaped wings of the gripping device according to the invention in section and schematically.

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Figs. 12 and 13 illustrate a fourth design of the gripping device according to the invention in various phases in section and schematically.

30 Figs. 14 to 16 show a further possible development of a jaw-like gripping device which can be opened and closed, in diagram and schematically.

With a urinary calculus problem, many complaints and complications result from the fact that a stone 1 which has passed out of the kidney 2, has become trapped by being wedged in or similar in the ureter 3 which leads to the

bladder 4. If the stone cannot be passed naturally out of the ureter, a procedure using surgical instruments in the treatment of the urinary calculus problem is often required. A catheter 5 serves for this purpose, which is to be inserted into the ureter and has a gripping device 6 at the front end. The gripping device 6 has a cup-shaped head 7 which can be opened and closed by a pulling and pushing unit 8, e.g. a flexible cable, guided in the catheter tube 5.

In the version of Figs. 1 to 7, the cup-shaped gripping device is formed from leaf-shaped wings 9 which run curved inwards in cross-section and are swivellable about axes 10 which are housed in the catheter tube 4. The leaf-shaped wings 9 can be provided on the inside with projections 11 which are connected in articulated manner by butt straps 12 to the upper part 13 of the flexible pulling and pushing unit 8.

In the closed position of the leaf-shaped wings 9, the latter essentially form a dome-shaped continuation of the catheter tube 5 which can have a slightly reinforced wall at the end. This is however not absolutely necessary. By pulling on the pulling and pushing unit 8 at the rear end of the catheter tube 5, via which the unit 8 is guided out and can be provided with a lock, the catching head 7 is necessarily kept in the closed position. After the catheter tube 5 has been pushed into the ureter 3 to just before the stone 1, the leaf-shaped wings 9 can be opened by the action of force by advancing the unit 8 vis-à-vis the catheter tube 5 kept stationary so that the wings are spread apart and form a jaw-like opening 14. This makes possible a gentle widening of the wall of the ureter 3 (Fig. 2) far enough for the stone 1 to be able to detach itself from the wall of the ureter. The stone can optionally fall into the opened mouth 14 of the gripping device 7 in little pieces. However, by carrying out the closing movement of the leaf-shaped wings 9, the stone can also be grasped and held clamped. The closing of the leaf-shaped wings is carried out by pulling out the pulling and pushing unit 8 relative to the catheter tube 5, the stone which has fallen in being able to be enclosed by the wings or else only partly held clamped. The catheter is then guided together with the gripping device and the stone out of the ureter 3.

With the gripping device 16 of Figs. 8 to 10, the leaf-like wings 17 are opened and closed in the manner of a spatially designed iris diaphragm is involved.

The wings 17 overlap somewhat. They bear projections 18 which face

5 inwards between which a spring unit 19, e.g. a helical spring or else a suitable buffer unit of rubber-elastic material, can be housed, an annular wire 20 being able to be provided as a guide for the helical springs. The wings 17 are housed with their lower part 17a, which expediently runs conically, in a rigid and stiff conical section 5a of the catheter tube 5. The wings 17 can be  
10 provided at the lower end with a bent annular flange part 17b covered by a projecting collar 8a of the pulling and pushing unit 8. As a result of the elastic elements 18 arranged between the wings 17, the wings are kept spread apart with the result that a wide-open jaw 21 is formed. By pulling of the pulling and pushing unit 8 relative to the catheter tube 5, the wings 17 are pulled to a  
15 greater or lesser extent into the cone section 5a with the result that the wings close up to a greater or lesser extent in the manner of an iris diaphragm and are necessarily kept in this position. The result of the development of the wings 17 is that in the closed position the wings close up tightly with their free ends, which improves the insertion of the catheter into the ureter.

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In the version of Fig. 11, the gripping device 23 is developed such that the leaf-shaped wings 24 form part of the catheter tube 5. The front end 13 of the pulling and pushing unit 8 is provided with sprung bars 25 which are securely connected with their free ends to the wings 24, which can be achieved with an  
25 adhesive or weld connection. When the pulling and pushing unit 8 is pulled towards the catheter tube 5, the leaf-shaped wings 24 can be kept in the closed position with the result that an easy insertion of the catheter into the ureter mouth is made possible. By pushing in the pulling and pushing unit 8 relative to the catheter tube 5, the wings 24 are moved into the spread open  
30 position in order to be able to expand the ureter and move the stone into the loose position.

In the further version 27 of Figs. 12 and 13, the wings 28 likewise form part of the catheter tube 5. The wings 28 can each be provided with moulded-in

spring plates 29. The front end 13 of the pulling and pushing unit 8 is provided with a cone section 30 which lies in the cavity of the strongly arched wings 28, the wings 28 being located in the closed position (Fig. 12). By advancing the cone section 30 of the pulling and pushing unit 8, the wings 28 are moved into the open position and thus form a wide open jaw 31 for expanding the ureter and for loosening the stone.

In the design of the gripping device 33 of Figs. 14 and 16, the catheter tube 5 is provided at the free end with an elastic section 34 running conically outward, which in its original shape forms a wide jaw. An encircling pull cord 35 can be connected to the cone-shaped section 34 which is secured with its end 35a to the section 34. The pull cord can be housed displaceable in the wall of the cone section 34. The other part 35b of the pull cord leads through a prepared bore into the inside of the catheter tube 5, the following part 35c being able to run in the cavity of the catheter tube 5 and be guided out of the catheter tube to an activation lock. If the pull cord 35 is pulled out relative to the catheter tube 5, the annular part of the pull cord causes a contraction of the conical section 34 with the result that the catheter can be easily inserted into the ureter. As soon as the stone 1 trapped in the ureter 3 is reached, the pull cord is relaxed, whereupon the conical section 34 of the catheter tube 5 moves outwards through its own elastic properties and forms a wide mouth 36. As a result of the expansion of the ureter, the stone 1 can reach the jaw 36. By pulling on the pull cord 35, the stone 1 is held clamped, whereupon the catheter 5 together with the stone can be pulled out of the ureter.